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**Wark**

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(54) **METHODS FOR USING AN INTERPOSER/ CONVERTER TO ALLOW SINGLE-SIDED CONTACT TO CIRCUIT MODULES**

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(51) **Int. Cl.<sup>7</sup>** ..... **G01R 31/02**

(52) **U.S. Cl.** ..... **324/761; 439/326; 324/763**

(58) **Field of Search** ..... **324/754-759, 324/761, 763-764; 439/59, 66, 74, 75, 137, 326, 329, 786, 796, 637, 638, 482**

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

3,701,071 A	10/1972	Landman	.....	200/5 R
3,746,932 A	7/1973	Hogan et al.	.....	361/785
4,718,859 A	1/1988	Gardner	.....	439/329
5,256,078 A	10/1993	Lwee et al.	.....	439/326
5,334,030 A	8/1994	Brilliott	.....	439/75
5,337,220 A	8/1994	Granitz	.....	361/816

5,511,985 A	*	4/1996	Noschese et al.	.....	439/157
5,514,002 A		5/1996	Cheng et al.	.....	439/326
5,525,812 A		6/1996	Bandzuch et al.	.....	257/48
5,657,081 A		8/1997	Kurahashi	.....	348/231
5,690,502 A		11/1997	Mochizuki	.....	439/320
5,695,354 A		12/1997	Noda	.....	439/326
5,697,802 A		12/1997	Kawabe	.....	439/326
5,779,494 A		7/1998	Ito et al.	.....	439/326
5,833,478 A	*	11/1998	Tseng et al.	.....	439/326
6,218,852 B1	*	4/2001	Smith et al.	.....	324/761

**FOREIGN PATENT DOCUMENTS**

JP 60-173790 7/1985 ..... G11C/5/00

\* cited by examiner

*Primary Examiner*—N. Le

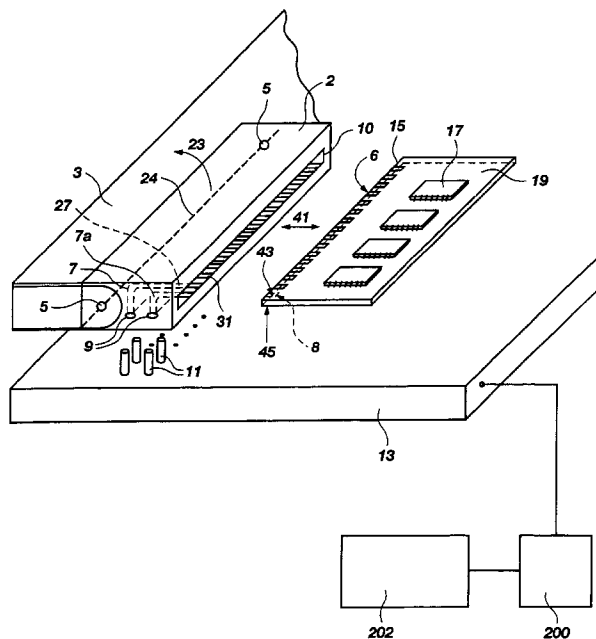
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(57) **ABSTRACT**

An apparatus and method for routing all external connection points of a dual-sided edge connector of a circuit card to one side of a test tray suitable for testing with a bed of nails, "pogo pin" or similar type of load board for functional testing of a circuit card. A first embodiment of the apparatus includes a pivotally mounted or snap-in removable electrical and mechanical receptacle with a slot or socket suitable for holding a dual-sided edge connector of a circuit card in a test tray. The receptacle pivots or is otherwise mounted in the test tray to allow the circuit card to lie coplanar with the test tray, thus providing perpendicular contact to the pins of a bed of nails-type load board. Another embodiment provides a fixed receptacle mounted vertically that routes all edge connector traces to the bottom surface of the test tray, again, suitable for engaging with a bed of nails-type test board.

**16 Claims, 5 Drawing Sheets**



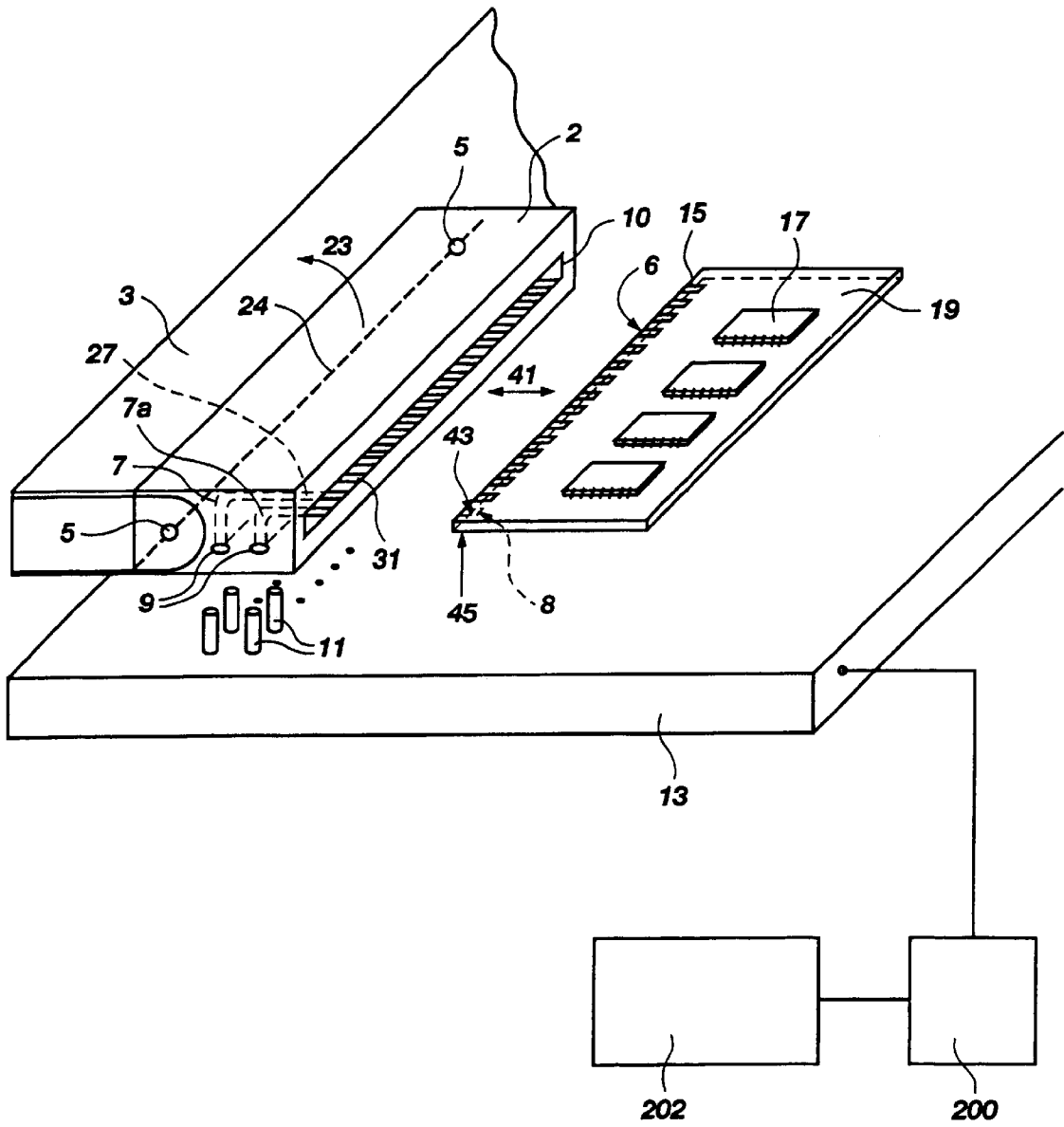


Fig. 1

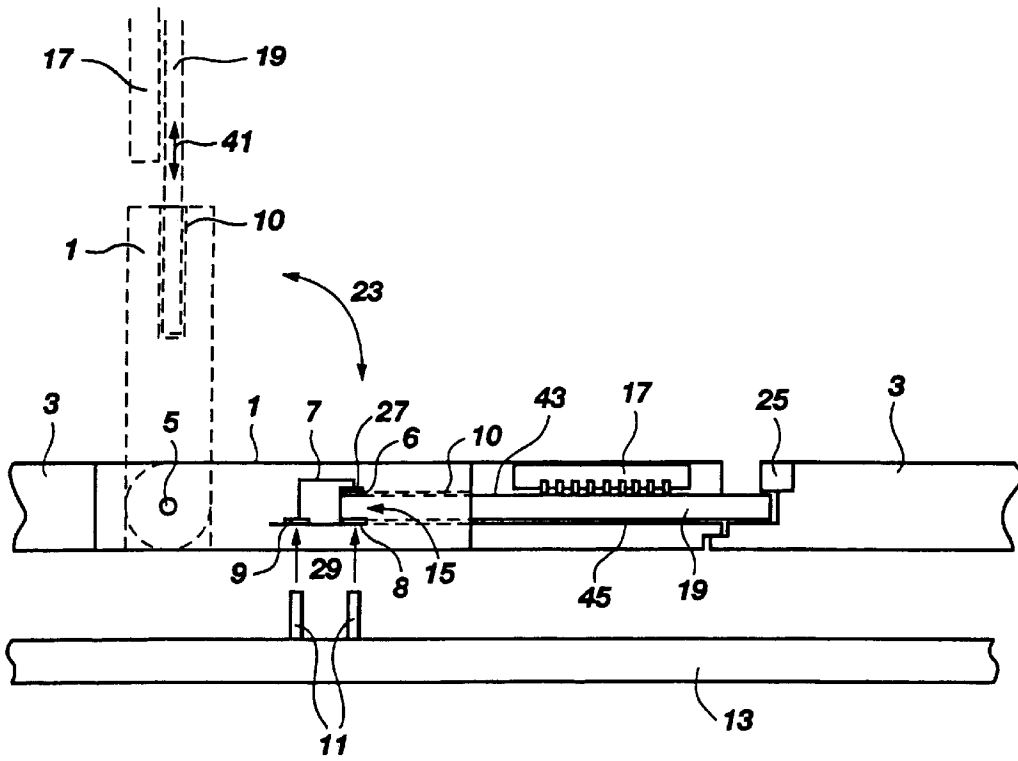


Fig. 2A

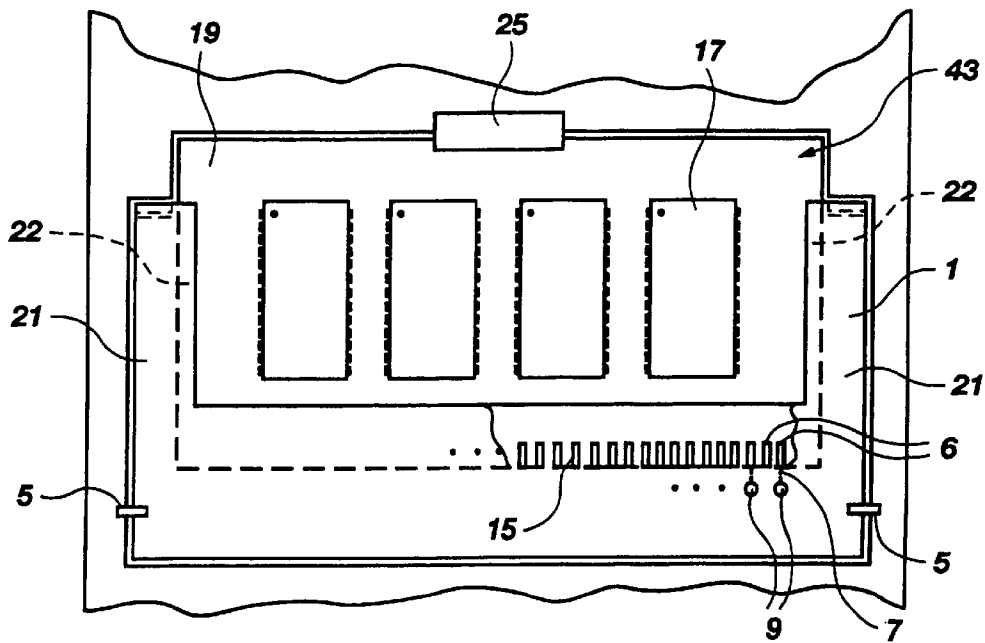


Fig. 2B

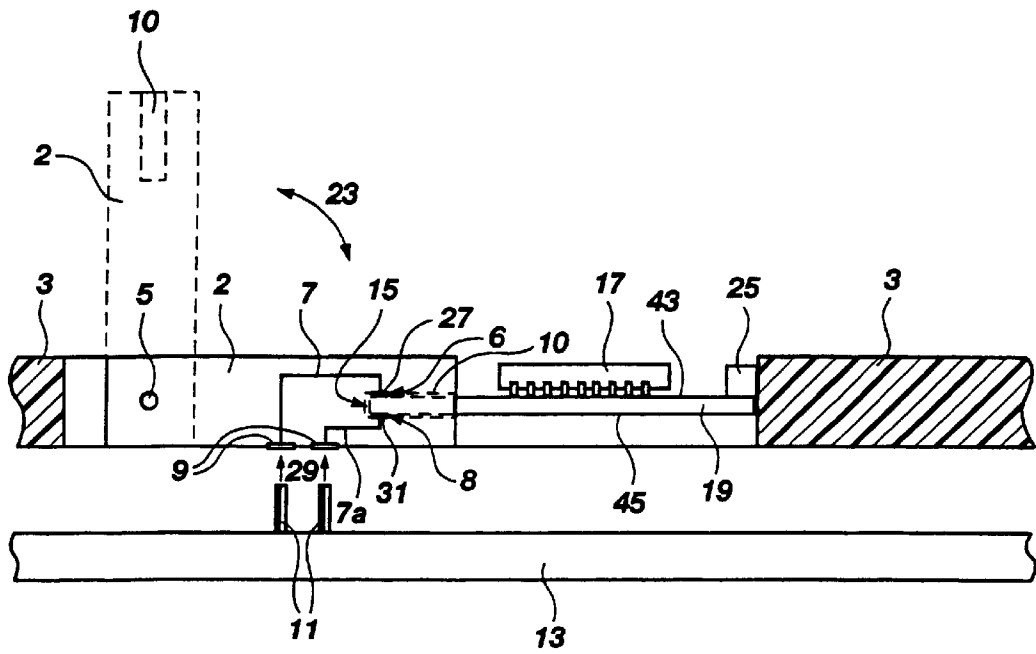


Fig. 3

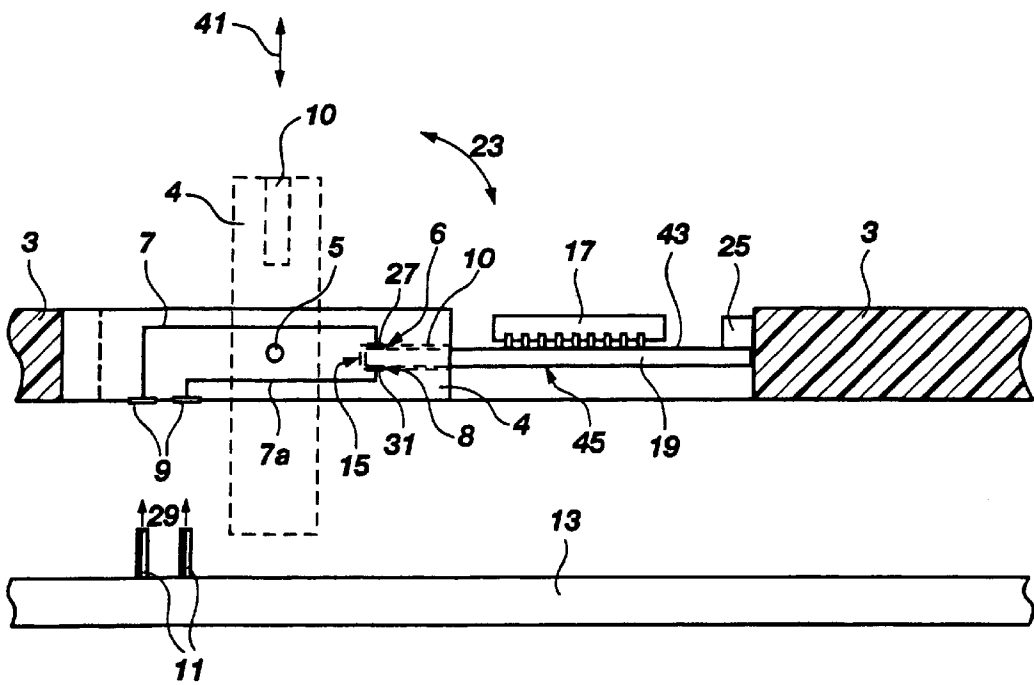


Fig. 4

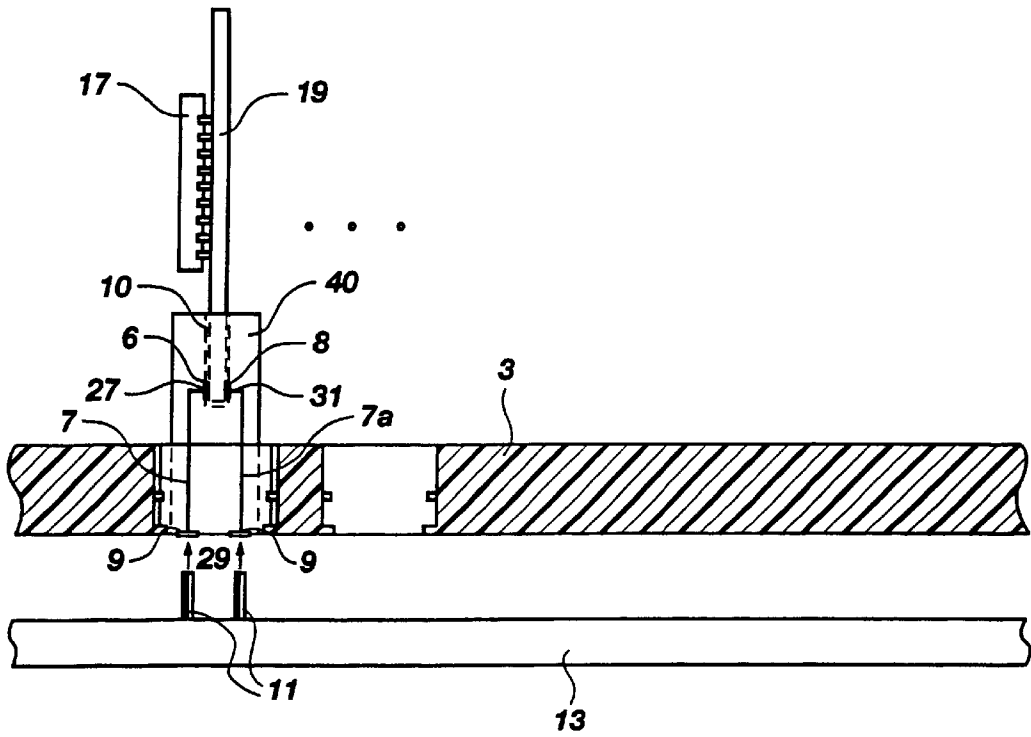


Fig. 5

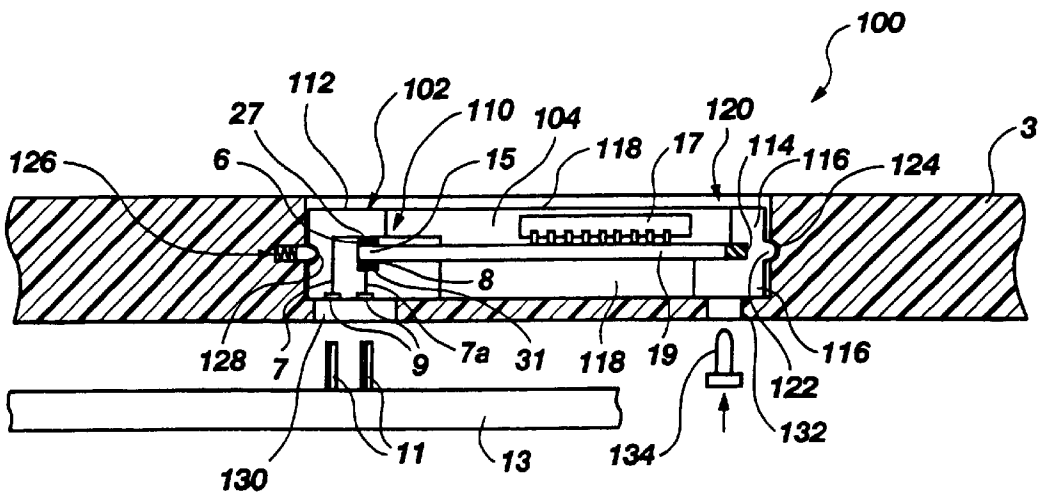
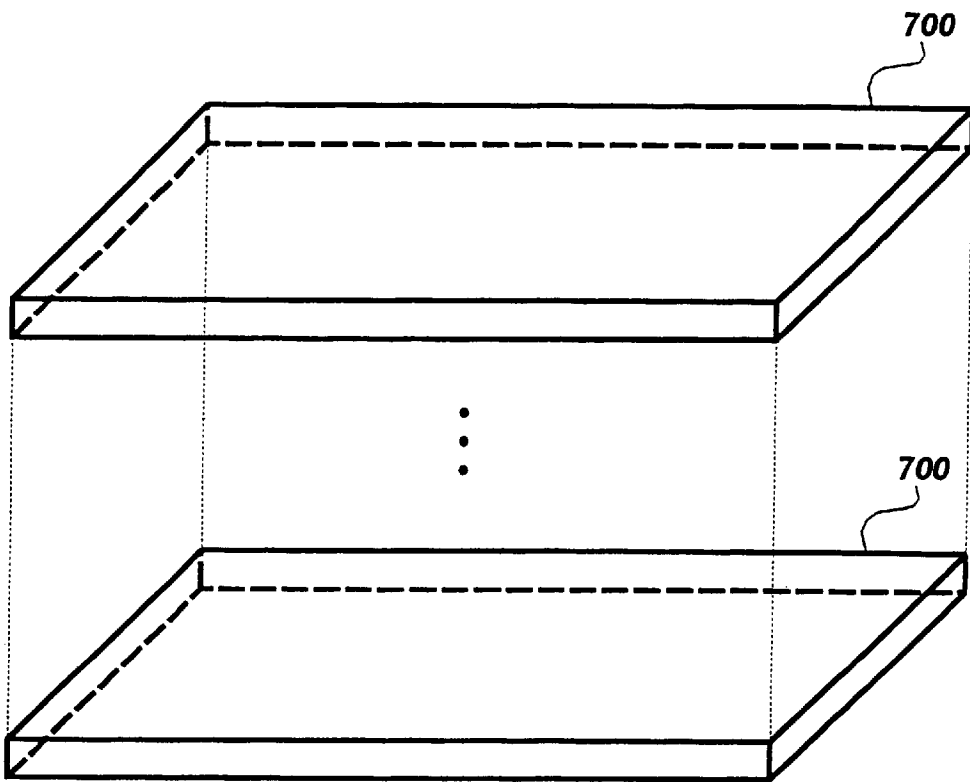


Fig. 6



**Fig. 7**

## METHODS FOR USING AN INTERPOSER/ CONVERTER TO ALLOW SINGLE-SIDED CONTACT TO CIRCUIT MODULES

### CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a divisional of application Ser. No. 09/414,203, filed Oct. 7, 1999, now U.S. Pat. No. 6,200,144, which is a divisional of application Ser. No. 08/810,048, filed Mar. 4, 1997, now U.S. Pat. No. 6,004,142, issued Dec. 21, 1999.

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates to an interface adapter for providing single-sided electrical contact to a circuit card bearing contact elements on two sides.

#### 2. State of the Art

Modern personal computers are designed to be easily upgraded by swapping out old components and replacing them with newer, faster, and higher capacity parts. For example, computer memory such as dynamic random access memory (DRAM) is upgraded by inserting single in-line memory modules (SIMMs) into preexisting sockets on a motherboard. SIMMs are small circuit cards with memory chips attached and a single-sided edge connector having a data width of 32-bits. Dual in-line memory modules (DIMMs) provide greater data widths (64- and 72-bits) and higher memory density, particularly useful for size-limited applications such as notebook computers. Microprocessors are also trending toward greater data (word) widths. DIMMs have dual-sided edge connectors to maintain a small form factor with wider data widths. The trend in state-of-the-art microprocessors is also toward wider word widths. This trend is generating demand for higher performance memory components such as DIMMs.

SIMMs and DIMMs are tested for burn-in (infant mortality) and functionality. For purposes of burn-in testing, standard SIMM and DIMM sockets can be used to test for infant mortality. Functional testing is performed on automatic test equipment, typically with a "bed of nails" type interface which was originally designed to simultaneously test a plurality of individually packaged dice. However, in the case of a SIMM card, with its single line of edge contacts on one side of the card, such test equipment may be easily adapted to electrically connect to the contacts of SIMM cards placed flat in a carrier tray such as a JEDEC (Joint Electronic Device Engineering Council)-configured tray. In such a case, eight to ten of the SIMM cards may be tested per tray on a tester of the aforementioned configuration at one time.

The current generation of circuit card test trays for SIMMs are not, however, adaptable to handle the dual-sided connectors of DIMMs because one-half of the edge connectors or contacts of the DIMM cards face opposite the test side of the tray by which contact is made. One possible solution is to design the DIMMs with through-hole or via-connected test pads extending from one side of the card to the other side, thus providing all edge connector contacts on one side of the card for test purposes. However, this potential solution requires greater use of limited circuit board real estate, as well as greater cost because of the additional traces and through-holes required. Moreover, the added conductive trace complexity may introduce more defects into the cards themselves, lowering yield for other than die-related failures.

Other circuit boards and cards employing dual-sided connectors and presenting similar test and contact problems include (by way of example only) other multichip modules (MCMs) including other dice in addition to or in lieu of memory dice, as well as triple in-line memory modules (TRIMMs).

Electrical sockets for connecting SIMMs are taught by Lwee et al. (U.S. Pat. No. 5,256,078, Oct. 26, 1993, hereinafter the "'078" patent). Electrical sockets for connecting DIMMs are taught by Noschese et al. (U.S. Pat. No. 5,511,985, Apr. 30, 1996, hereinafter the "'985" patent). While suitable for burn-in testing, neither the '078 patent nor the '985 patent teach a circuit card receptacle for routing edge connector traces from one side of the circuit card to the other side to facilitate testing of the card from a single side. Thus, there is a need in the art for a circuit card receptacle which allows single-sided testing of circuit cards or boards having dual-sided edge connectors to avoid the necessity for investing in new and different test equipment to accommodate such dual-sided connector configurations.

### BRIEF SUMMARY OF THE INVENTION

The invention comprises, in several embodiments, a circuit card receptacle for routing dual-sided edge connectors from any kind of multichip module (MCM) for effecting electrical contact from a single side of the receptacle. The invention may be combined with a test tray suitable for automatic testing of MCMs with automatic test equipment utilizing a bed of nails or other probe-type load board interface.

In the first embodiment of the invention, a U-shaped receptacle for circuit cards bearing dual-sided edge connectors or contacts is provided. The U-shaped receptacle allows direct connection of a "bed of nails" type load board to edge connectors on one side of a circuit card, termed for convenience the "test" side, and additionally provides test pads on the test side of the receptacle electrically connected to the nontest side edge connectors of the circuit card. The U-shaped receptacle is preferably pivotally mounted on a test tray for easy insertion and removal of the circuit cards and correct placement of the test pads to face the bottom of the tray.

A second embodiment of the invention also provides a circuit card receptacle pivotally mounted on a test tray. When viewed from a side elevation, the circuit card receptacle routes edge connector traces from both sides of the card to test pads on one surface of the receptacle located between the pivot point and the edge connector receptacle.

A third embodiment of the invention also provides a circuit card receptacle pivotally mounted on a test tray and, as illustrated, routes dual-sided edge connector traces to test pads on one surface of the receptacle. In this embodiment, a side elevation view reveals that the receptacle contains a pivot point located between test pads routed from edge connector traces and the edge connector receptacle.

It should be noted that the first embodiment may employ a pivot point located between the test points and the bottom or base of the "U," or a pivot point may be on the legs of the "U."

In the fourth embodiment, fixed circuit card receptacles are mounted on a test tray such that circuit cards inserted in the receptacles are perpendicular to the test tray. In this embodiment, both sets of edge connector traces of the card are routed to test pads located on the underside of the tray. This embodiment provides greater card density for testing in comparison to the others if suitable test equipment is avail-

able. Hereinafter, this embodiment is referred to as the fixed perpendicular embodiment.

An alternative means, and a fifth embodiment, for mounting the card receptacles on the test tray is the use of a quick-release mechanism for securing and removing each card receptacle from the tray. This method of mounting provides the advantages of the pivot mounting arrangements, first, by facilitating insertion and removal of circuit cards from the receptacle and, second, by allowing the receptacle with card inserted to be held coplanar with the test tray. Thus, a quick-release mechanism could be substituted for the pivot mounting mechanisms described in the first three embodiments above.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a perspective, generic view of the invention as used with a test tray and a multichip module to be tested.

FIGS. 2A and 2B are side elevation and top views of a first embodiment of the invention employing a U-shaped, pivoting receptacle.

FIG. 3 is a side elevation of a second embodiment of the invention where the test pads are located between the pivot point of a pivotable circuit card receptacle and the edge connector receptacle.

FIG. 4 is a side elevation of a third embodiment of the invention where the pivot point of a pivoting circuit card receptacle is located between the test pads and the edge connector receptacle.

FIG. 5 is a side elevation of a fourth embodiment of the invention, also referred to as the fixed perpendicular embodiment, where the circuit card receptacles are rigidly fixed to the test tray which holds circuit cards under test perpendicular to the test tray.

FIG. 6 is a side elevation of a fifth embodiment of the invention, wherein a quick-release mechanism employing a snap-in type receptacle is used in lieu of a pivoting receptacle.

FIG. 7 is a perspective view of stackable test trays suitable for use with the receptacle embodiments illustrated in FIGS. 1, 2A, 2B, 3, 4 and 6.

#### DETAILED DESCRIPTION OF THE INVENTION

An understanding of the detailed description of the invention is facilitated by drawing FIGS. 1 through 7. The embodiments of the invention each solve the problem of interfacing a dual-sided circuit card to a single-sided load board used in functional testing without resorting to expensive retooling of the tester interface or purchase of different test equipment.

FIG. 1 shows an exemplary, pictorial view of the invention comprising a circuit card receptacle 2 mounted on a test tray 3. The test tray 3 could be fabricated with any number of receptacles 2, limited only by tray size and the number of circuit card test pins 11 (also termed "pogo pins," "nails" or "probes") available on the load board 13. Load board 13 is connected to a test interface adapter 200, which in turn is connected to a functional test system 202 comprising a computer controlled by a software test program. FIG. 1 shows a representative circuit card 19 which is to be inserted 41 into the receptacle 2. The circuit card 19 has a dual-sided edge connector 15 with two rows of edge connector traces 6 and 8, one on the nontest side 43 and another (not visible in FIG. 1) on the test side 45. Mounted on the circuit card

19 are integrated circuit dice 17. The circuit card 19 engages the receptacle 2 at a socket or slot 10, which may be formed with either closed or open lateral ends but, if with open ends, also providing tabs or stops proximate each end for proper lateral card location. The edge connector traces 6 of nontest side 43 of the circuit card edge connector 15 connect with mating edge contacts 27 (one shown in broken lines in FIG. 1) within the slot 10 connected to circuit traces 7 extending from within the socket or slot 10 to a first row of test pads 9 located on the test side of the receptacle 2. Similarly, the edge connector traces 8 of test side 45 of the circuit card edge connector 15 connect with mating edge contacts 31 within the socket or slot 10 connected to circuit traces 7a extending from within the socket or slot 10 to an additional, second row of test pads 9 also located on the test side of receptacle 2. Mating edge contacts may comprise any suitable structures, such as leaf spring contacts or zero-insertion-force (ZIF) contacts. Further, circuit traces 7 and 7a are desirably routed and configured for minimal length and matched impedance. The receptacle 2 is rotatable as shown at 23 about an axis 24 extending between pivot or hinge points 5 to facilitate insertion and removal 41 of the circuit card 19 under test. The test pins or probes 11 of the load board 13 mechanically contact and electrically communicate with the test pads 9 arrayed in a mating configuration when the test tray 3 is aligned and engaged with the load board 13. The five embodiments of the invention are described in further detail in FIGS. 2 through 7.

FIG. 2A shows a side cross-sectional elevation of the first embodiment of the invention. A U-shaped half-socket receptacle 1 is provided to route the edge connector traces 6 on nontest side 43 of circuit card 19 to test pads 9 by circuit traces 7, using mating edge contacts 27. This embodiment further allows direct connection 29 to test side edge connector traces 8 on the circuit card 19. It should be noted that, in this embodiment, test pads 9 and test side edge connector traces 8 lie in a substantially coplanar relationship parallel to the plane of test tray 3 for coequal contact with load board 13. Since only one side of circuit card 19 is connected by circuit traces 7 to test pads 9, while connector traces 8 make direct contact with test pins 11, it may be desirable to include components in circuit traces 7 so that impedance matching may be achieved. The half-socket receptacle 1 is pivotally mounted 5 on a test tray 3 to allow: (1) linear insertion and removal 41 of a circuit card 19 to be tested, and (2) rotation 23 of the circuit card 19 until it is coplanar with the test tray 3 and ready to interface with the "pogo" pins or nails 11 on the load board 13. FIG. 2B shows the circuit card 19 held in the half-socket receptacle 1 by slots 22 in legs 21 of the "U" engaging the lateral marginal extremities of the circuit card 19. The circuit card 19, inserted in the half-socket receptacle 1, is held coplanar within the test tray 3 by a retaining clip 25 extending or protruding from test tray 3 to engage the top of the circuit card opposite the edge connector 15. The retaining clip 25 could be of any conventional design such as a leaf or bow spring, a spring-loaded ball detent, or a pivoting post, and so will not be further described herein. This embodiment may be modified to provide test pads electrically connected to edge connector traces 6, 8 on both sides of a circuit card 19 by configuring receptacle 1 as shown in FIGS. 3 and 4 and subsequently described herein.

FIG. 3 is a side elevation of the second embodiment of the invention. A receptacle 2 including a slot or socket 10 is provided to route connector traces or contacts 6, 8 from both sides of the dual-sided edge connector 15 to test pads 9 on receptacle 2. The receptacle 2 is pivotally mounted at 5 to the test tray 3 and locates test pads 9 between the pivot point



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5 and the circuit card socket or slot 10. Like the first embodiment, the receptacle 2 is pivotally mounted on a test tray 3 to facilitate insertion and removal 41 of the circuit card 19 and rotation 23 of the circuit card 19 until it is coplanar with the test tray 3 and ready to interface with the pogo pins 11 of the load board 13. The circuit card 19 is held in the receptacle 2 by socket or slot 10. The edge contacts 27 and 31 of socket 10 mechanically and electrically engage the connector traces 6, 8 of dual-sided edge connector 15 of the circuit card 19 and are respectively routed to test pads 9 by circuit traces 7 and 7a of receptacle 2. The circuit card 19 is held coplanar within the test tray 3 by a retaining clip 25 of any suitable configuration, as previously discussed, at the edge of the circuit card opposite that occupied by the edge connector 15.

FIG. 4 shows a side elevation of the third embodiment of the invention. A receptacle 4 is provided to route connector traces or contacts 6, 8 from opposing sides of the dual-sided edge connector 15 to test pads 9 on receptacle 4. The socket 4 is pivotally mounted at 5 to the test tray 3. The pivot point 5 is located between the test pads 9 and the circuit card slot 10 of receptacle 4. Like prior disclosed embodiments, the receptacle 4 is pivotally mounted on a test tray 3 to allow insertion and removal 41 of the circuit card 19 under test and rotation 23 of the circuit card until it is coplanar with the test tray 3 and ready to interface with the pogo pins 11 on the load board 13. The circuit card 19 is held in the receptacle by a socket or slot 10, which mechanically and electrically engages the dual-sided edge connector 15 of the circuit card 19. The circuit card 19 is held coplanar within the test tray by a retaining clip 25 of suitable design at the end opposite the edge connector. The advantage of this embodiment over the second embodiment is that the direct connection 29 of the pogo pins 11 against the test pads 9 tends to hold the circuit card coplanar within the test tray 3, permitting use of a much less robust retaining clip 25, or eliminating the need for same altogether. The first embodiment may be modified in a similar manner by movement of pivot or hinge points accordingly.

A fourth embodiment of the invention, shown in FIG. 5, provides a plug-in receptacle 40 removably mounted on a test tray 3 such that each circuit card 19 under test is mounted perpendicular to the test tray 3. In this embodiment, the circuit card 19 is received in a socket or slot 10 and the receptacle 40 routes connector traces 6 and 8 by circuit traces 7 and 7a to test pads 9 on the bottom of the receptacle 40. While receptacle 40 is preferably formed separately from test tray 3 and is plugged therein in a snap-in fashion as depicted in FIG. 5, a tray with a plurality of integrally-molded receptacles 40 may be fabricated. The advantage of this embodiment is that potentially more circuit cards could be mounted on a tray. However, this embodiment does not facilitate stacking of trays with mounted circuit cards 19 ready to test because the circuit cards 19 project from the plane of the tray. In comparison, test trays incorporating the first three embodiments can be stacked easily to facilitate movement and storage of the loaded test trays in an automated production test environment. Further, the circuit density in the fixed perpendicular embodiment may require upgraded test equipment.

The various pivot mounting mechanisms described above may be replaced by a quick-release mechanism, such as depicted in FIG. 6. Such a quick-release mechanism allows rapid fixing and removal of the receptacle to, in turn, facilitate insertion and removal of the circuit card to be tested. The quick-release mechanism also allows the card and receptacle combination to lie coplanar with the test tray,

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as with the pivoting embodiments. Once the cards and receptacles are secured, the entire tray can be interfaced with a bed of nails-type load board on a functional tester. Thus, a quick-release mechanism substitutes for the pivot mount. The pivot mounting scheme is preferable only because it is integrated, whereas the quick-release scheme permits pre-loading of circuit cards in receptacles for subsequent insertion in trays. Trays using both pivoting and quick-release receptacles may be easily stacked.

FIG. 7 illustrates stackable test trays 700 according to the invention. Stackable test trays 700 may include pivoting or quick-release receptacles as described above and illustrated in FIGS. 1, 2A, 2B, 3, 4 and 6.

The quick-release mechanism 100 as shown in FIG. 6 comprises a rectangular, window frame-type receptacle 102 into which a circuit card 19 may be inserted. Receptacle 102 includes an upper window 104 in its upper surface (as depicted in FIG. 6) through which circuit card 19 may be inserted with its dual-sided edge connector 15 extending into shallow slot 110 in receptacle base 112 wherein edge contacts 27 and 31 respectively mechanically and electrically engage connector traces 6, 8 of dual-sided edge connector 15. Edge contacts 27 electrically communicate through circuit traces 7 with a first set of test pads 9 on the bottom of receptacle 102, while edge contacts 31 communicate through circuit traces 7a with a second set of test pads 9 coplanar with the first set. Circuit card 19 is maintained in slot 110 by an elastomeric biasing pad 114 carried by receptacle header 116. Base 112 and header 116 are joined by side columns 118 extending transversely therebetween. Biasing pad 114 needs to provide only a nominal bias to retain circuit card 19 in receptacle 102 during handling and testing, as receptacle 102, and not circuit card 19, sustains the transverse mechanical loading imposed by contact of test pins 11 with test tray 3. Receptacle 102, in turn, is secured within receptacle bay 120 of test tray 3 by engagement of linear protrusion 122 (which extends across the top of header 116) with slot 124 on one end of bay 120, while a detent 126 (shown here by way of example as a coil-spring-biased, bullet-shaped element with a hemispherical head) engages dimple or cavity 128 in receptacle base 112. Test pads 9 are exposed to test pins 11 through test aperture 130 in the bottom of receptacle bay 120 in test tray 3.

In operation, circuit card 19 is loaded into a receptacle 102 as previously discussed. Receptacle 102 is then snapped into a bay 120 in a test tray 3 (each test tray preferably having a number of such bays formed therein), each bay 120 receiving a receptacle 102 carrying a circuit card 19. A tray of circuit cards 19 is then tested on load board 13, pogo pins 11 contacting test pads 9 associated with each circuit card 19. After load testing, receptacles 102 are unloaded by pulling them out of bays 120 transverse to the plane of test tray 3, overcoming the spring bias of detent 126. The insertion and removal operation may be manual, and fingerholds (not shown) may be provided on receptacle 102. Further, an access window 132 may be provided in the bottom of each bay 120 so that a pin-type removal mechanism 134 may engage the headers 116 of receptacles 102 and "pop" them out of test tray 3, as shown. Receptacles 102 may also be employed for storage, handling and testing of circuit cards 19 before and after load testing for protection of circuit cards 19.

It will be understood that all of the embodiments herein should be formed of a low-static plastic or other polymers, or include an antistatic coating thereon. It will be further understood that each receptacle embodiment may be tailored for a specific card configuration (size and shape, number of

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contacts, contact pitch, etc.), and that such receptacles will preferably be configured on their exteriors to be interchangeable on carrier trays, in terms of interchangeability of receptacles for others of the same embodiment.

Although the present invention has been described with reference to particular embodiments, the invention is not limited to these described embodiments and additions, deletions and modifications to the disclosed embodiments, including without limitation the combination of features of different embodiments, will be apparent to those of ordinary skill in the art and lie within the scope of the claims following this specification.

What is claim is:

1. A method of contacting a circuit card bearing a dual-sided edge connector, comprising:

- providing a circuit card having a dual-sided edge connector;
- providing a circuit card receptacle comprising:
  - an elongated slot structure for receiving said dual-sided edge connector of said circuit card;
  - two groups of contacts mounted within said elongated slot structure, the first group configured for mating with a first side of said dual-sided edge connector and the second group configured for mating with a second and opposing side of said dual-sided edge connector;
  - planar electrical test pads coplanar with a single surface of said receptacle configured for mechanical contact with test pins from a load board; and
  - circuit traces carried by said circuit card receptacle connecting said contacts to said planar electrical test pads;
- inserting said circuit card into said circuit card receptacle; and
- contacting said planar electrical test pads with said test pins from said load board.

2. The method of claim 1, further comprising after said inserting said circuit card into said circuit card receptacle, snapping said circuit card receptacle into a bay in a test tray.

3. A method of testing a circuit card having a dual-sided edge connector, comprising:

- providing a circuit card receptacle comprising:
  - an elongated slot structure for receiving said dual-sided edge connector of said circuit card;
  - two groups of contacts mounted within said elongated slot structure, the first group configured for mating with a first side of said dual-sided edge connector and the second group configured for mating with a second and opposing side of said dual-sided edge connector;
  - planar electrical test pads coplanar with a single surface of said circuit card receptacle configured for mechanical contact with test pins from a load board; and
  - circuit traces carried by said circuit card receptacle connecting said contacts to said planar electrical test pads;
- providing a circuit card tester having a load board for direct contact to said planar electrical test pads;
- providing a circuit card having a dual-sided edge connector;
- inserting said circuit card into said circuit card receptacle;
- contacting said planar electrical test pads with said test pins from a load board; and
- performing a functional test of said circuit card.

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4. The method of claim 3, further comprising:

- removing said circuit card from said circuit card receptacle;
- obtaining another circuit card having a dual-sided edge connector; and
- repeating said inserting step, said contacting step and said performing step.

5. A method of testing a circuit card bearing a dual-sided edge connector, comprising:

- providing a circuit card receptacle comprising:
  - an elongated slot structure for receiving said dual-sided edge connector of said circuit card;
  - two groups of contacts mounted within said elongated slot structure, the first group configured for mating with a first side of said dual-sided edge connector and the second group configured for mating with a second and opposing side of said dual-sided edge connector;
  - planar electrical test pads coplanar with a single surface of said circuit card receptacle configured for mechanical contact with test pins from a load board; and
  - circuit traces carried by said circuit card receptacle connecting said contacts to said planar electrical test pads;
- providing a circuit card tester having a load board for direct contact to said planar electrical test pads;
- providing a tray including bays for receiving circuit card receptacles;
- providing a circuit card having a dual-sided edge connector;
- inserting said circuit card into said circuit card receptacle;
- snapping said circuit card receptacle into a bay of said tray;
- contacting said planar electrical test pads with said test pins from said load board; and
- performing a functional test of said circuit card.

6. A method of testing circuit cards bearing a dual-sided edge connector, comprising:

- providing a plurality of circuit card receptacles, each circuit card receptacle comprising:
  - an elongated slot structure for receiving a dual-sided edge connector of a circuit card;
  - two groups of contacts mounted within said elongated slot structure, the first group configured for mating with a first side of said dual-sided edge connector and the second group configured for mating with a second and opposing side of said dual-sided edge connector;
  - planar electrical test pads coplanar with a single surface of said circuit card receptacle configured for mechanical contact with test pins from a load board; and
  - circuit traces carried by said circuit card receptacle connecting said contacts to said planar electrical test pads;
- providing a circuit card tester having a load board configured for direct contact to said planar electrical test pads;
- providing a tray including a plurality of bays for receiving said plurality of circuit card receptacles and orienting said planar electrical test pads along a single planar surface;
- providing a plurality of circuit cards each having a dual-sided edge connector for testing;

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inserting said plurality of circuit cards into said plurality of circuit card receptacles;  
 snapping said plurality of circuit card receptacles into said plurality of bays of said tray;  
 interfacing said tray including said planar electrical test pads with said test pins from said load board; and  
 performing a functional test of said plurality of circuit cards.

7. The method of claim 6, further comprising:

removing said plurality of circuit card receptacles from said plurality of bays of said tray;  
 removing said plurality of circuit cards from said removed circuit card receptacles; and  
 repeating said inserting step, said snapping step, said interfacing step and said performing step as necessary to test all of said plurality of circuit cards provided.

8. A method of contacting a circuit card bearing a dual-sided edge connector, comprising:

providing a circuit card having a dual-sided edge connector;

providing in combination, a substantially planar circuit card receptacle carrier and a circuit card receptacle for adapting a semiconductor die-carrying circuit card bearing a dual-sided edge connector for single-sided electrical contact, comprising:

an elongated cavity structure formed on said circuit card receptacle having two contact rows, each contact row comprising a plurality of contacts arranged for mating with one of two opposing sides of said dual-sided edge connector;

a plurality of test pads on a surface of said circuit card receptacle electrically connected to said plurality of contacts in a one-to-one correspondence, said test pads lying in a substantially coplanar relationship; and

a mechanism for coupling said circuit card receptacle to said substantially planar receptacle carrier, permitting insertion and removal of said circuit card from said receptacle carrier, while also allowing said circuit card to lie coplanar with said receptacle carrier where said circuit card receptacle is mounted thereto;

inserting said circuit card into said circuit card receptacle; and

contacting said plurality of test pads with a plurality of test pins from a load board.

9. The method of claim 8, further comprising after said inserting said circuit card into said circuit card receptacle, snapping said circuit card receptacle into a bay in said receptacle carrier.

10. A method of testing a circuit card bearing a dual-sided edge connector, comprising:

providing in combination, a substantially planar circuit card receptacle carrier and a circuit card receptacle for adapting a semiconductor die-carrying circuit card bearing a dual-sided edge connector for single-sided electrical contact, comprising:

an elongated cavity structure formed on said circuit card receptacle having two contact rows, each contact row comprising a plurality of contacts arranged for mating with one of two opposing sides of said dual-sided edge connector;

a plurality of test pads on a surface of said circuit card receptacle electrically connected to said plurality of contacts in a one-to-one correspondence, said test pads lying in a substantially relationship; and

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a mechanism for coupling said circuit card receptacle to said substantially planar receptacle carrier, permitting insertion and removal of said circuit card from said receptacle carrier, while also allowing said circuit card to lie coplanar with said receptacle carrier where said circuit card receptacle is mounted thereto;

providing a circuit card tester having a load board for direct contact to said test pads;

providing a circuit card having a dual-sided edge connector;

inserting said circuit card into said circuit card receptacle; contacting said plurality of test pads with a plurality of test pins from said load board; and

performing a functional test of said circuit card.

11. The method of claim 10, further comprising:

removing said circuit card from said circuit card receptacle;

obtaining another circuit card having a dual-sided edge connector for testing; and

repeating said inserting step, said contacting step and said performing step.

12. A method of testing a circuit card bearing a dual-sided edge connector, comprising:

providing in combination, a substantially planar circuit card receptacle carrier and a circuit card receptacle for adapting a semiconductor die-carrying circuit card bearing a dual-sided edge connector for single-sided electrical contact, comprising:

an elongated cavity structure formed on said circuit card receptacle having two contact rows, each contact row comprising a plurality of contacts arranged for mating with one of two opposing sides of said dual-sided edge connector;

a plurality of test pads on a surface of said circuit card receptacle electrically connected to said plurality of contacts in a one-to-one correspondence, said test pads lying in a substantially coplanar relationship; and

a mechanism for coupling said circuit card receptacle to said substantially planar receptacle carrier, permitting insertion and removal of said circuit card from said receptacle carrier, while also allowing said circuit card to lie coplanar with said receptacle carrier where said circuit card receptacle is mounted thereto;

providing a circuit card tester having a load board for direct contact to said plurality of test pads;

providing a circuit card having a dual-sided edge connector for testing;

inserting said circuit card into said elongated cavity structure of said circuit card receptacle;

snapping said circuit card receptacle into said receptacle carrier;

interfacing said receptacle carrier with said load board; and

performing a functional test of said circuit card.

13. A method of testing circuit cards bearing a dual-sided edge connector, comprising:

providing in combination, a substantially planar circuit card receptacle carrier and a plurality of circuit card receptacles, each circuit card receptacle configured for adapting a semiconductor die-carrying circuit card bearing a dual-sided edge connector for single-sided electrical contact, comprising:

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an elongated cavity structure formed on each circuit card receptacle having two contact rows, each contact row comprising a plurality of contacts arranged for mating with one of two opposing sides of said dual-sided edge connector;

5 a plurality of test pads on a surface of each circuit card receptacle electrically connected to said plurality of contacts in a one-to-one correspondence, said test pads lying in a substantially coplanar relationship; and

10 mechanisms for coupling said plurality of circuit card receptacles to said substantially planar circuit card receptacle carrier, each mechanism configured for permitting insertion and removal of a circuit card from said receptacle carrier, while also allowing said circuit card to lie coplanar with said receptacle carrier where each circuit card receptacle is mounted thereto;

15 providing a circuit card tester having a load board configured for interfacing with said receptacle carrier and configured for direct contact to said plurality of test pads;

20 providing a plurality of circuit cards each having a dual-sided edge connector for testing;

25 inserting said plurality of circuit cards into said plurality of circuit card receptacles;

snapping said plurality of circuit card receptacles into said receptacle carrier;

30 interfacing said receptacle carrier with said load board; and

performing a functional test of said plurality of circuit cards.

14. The method of claim 13, further comprising:

35 removing said receptacle carrier from said load board;

removing said plurality of circuit card receptacles from said receptacle carrier;

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removing said plurality of circuit cards from said removed circuit card receptacles; and

repeating said inserting step, said snapping step, said interfacing step and said performing step as necessary to test all of said plurality of circuit cards provided.

15. A method of contacting at least one circuit card bearing a dual-sided edge connector from a single side, comprising:

10 connecting at least one side of said dual-sided edge connector to planar electrical test pads located adjacent to and coplanar with an opposing side of said at least one circuit card; and

15 making simultaneous electrical contact to both sides of said dual-sided edge connector from said opposing side of said at least one circuit card, said contact with at least one side of said dual-sided edge connector being made through a plurality of test pins contacting said planar electrical test pads.

20 16. A method of testing a circuit card bearing a dual-sided edge connector from a single side, comprising:

25 connecting at least one side of said dual-sided edge connector to planar electrical test pads located adjacent to and coplanar with an opposing side of said circuit card;

30 making simultaneous electrical contact to both sides said of dual-sided edge connector from said opposing side of said circuit card, said contact with at least one side of said edge connector being made through a plurality of test pins contacting said planar electrical test pads; and

35 performing a functional test of said circuit card through said planar electrical test pads.

\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 6,710,614 B1  
APPLICATION NO. : 09/652408  
DATED : March 23, 2004  
INVENTOR(S) : James M. Wark

Page 1 of 1


It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

COLUMN 1, LINE 38, change "bum-in" to --burn in--  
COLUMN 1, LINE 39, change "bum-in" to --burn in--  
COLUMN 7, LINE 13, change "claim" to --claimed--

CLAIM 10, COLUMN 9, LINE 67, change "substantially relationship;" to  
--substantially coplanar relationship;--

Signed and Sealed this

Fifth Day of June, 2007



JON W. DUDAS

*Director of the United States Patent and Trademark Office*